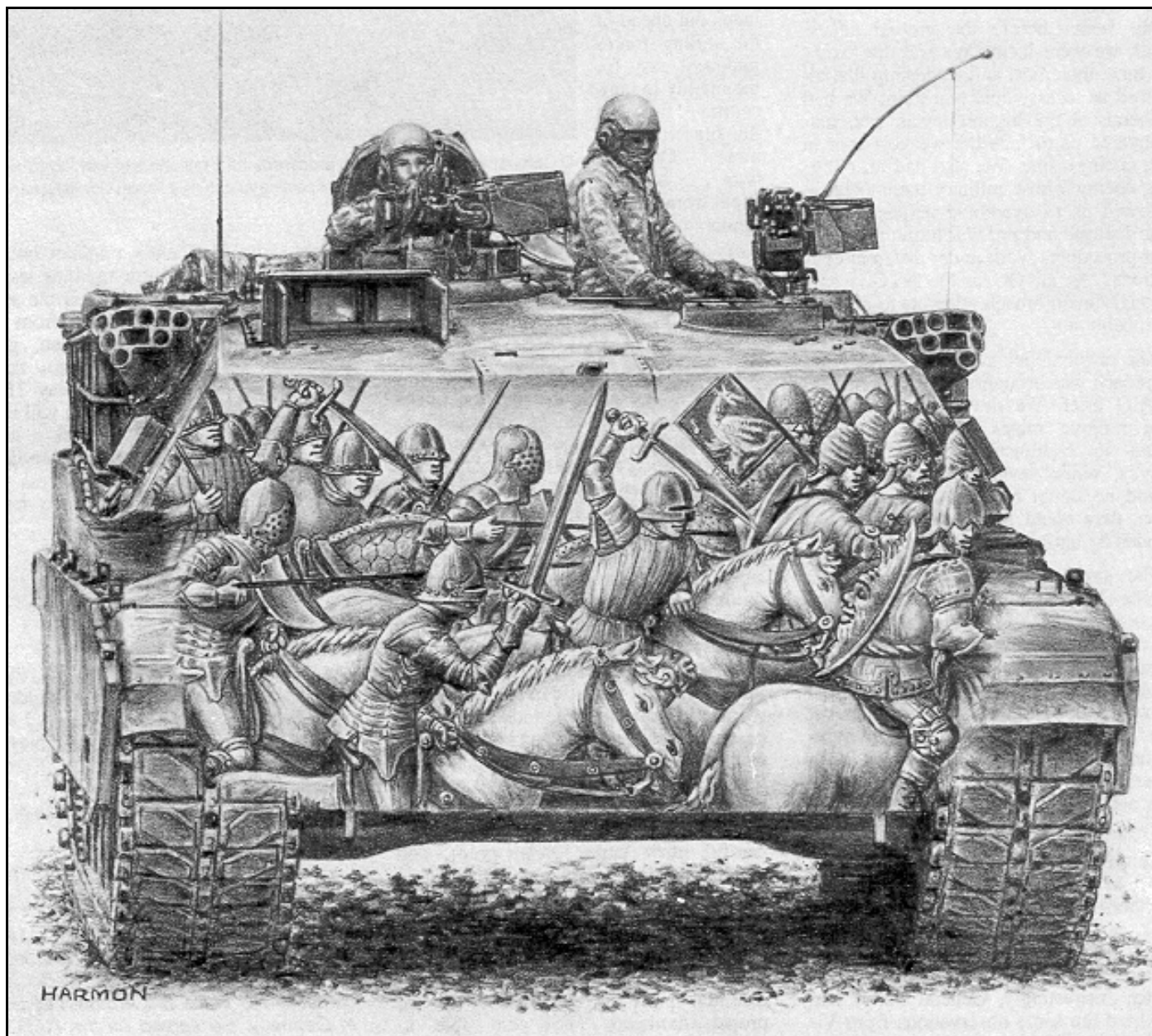# SHOCK
And the Digital Battlefield

by Captain Robert L. Bateman

SHOCK (shôk) v. intr. Archaic. To come into contact violently, as in battle; collide. [Old French choc, from choquer, to strike (with fear)[1]

Shock is a common term in the military lexicon of Western armed forces. It is generally considered as an asset, something one wishes would happen to the enemy and is often stated as a goal in a tactical operation. Yet, how many have considered exactly what they mean by "shock action"? Shock has the potential to be a terrible and effective weapon in its own right. An understanding of the

phenomena of shock is critical for the commander hoping to effectively employ it as a component of his plan, or as the objective result of his actions. Does the potential for shock exist on the modern battlefield? Today, many professionals differentiate between "shock" and "firepower." The implication here is that shock only refers to actual physical contact weapons, of which we have one, the

bayonet (discounting the more imaginative uses of the treads on some armored vehicles.) However, in the same breath many professionals also discuss the potential of "breaking" a unit. Is this not the classic definition of shock action? This apparent dichotomy in definitions is not resolved by our doctrine. This article examines shock, not only so that we might utilize it more effectively, but also so that we might better understand how it might be used against us.

Reviewing Shock

So long as men have attempted to better one another in physical matches, there has been shock. Currently, United States Army doctrine is silent on the topic. One finds neither a definition or a broad use of the term within FM 100-5 (*Operations*) or the subordinate tactical manuals. Failing a definition from these sources, one turns to the dictionary, where we find the definition above. So, for this article and for general military purposes, we will define shock as having two components: physical force (expressed as F=MxA) and fear. Physical force is the enabling component; fear is the active and primary component. This definition will be the basis of our discussion. Yet this definition did not appear from whole cloth; shock is a recognized aspect of combat, one that has been widely documented, if less often defined.

The mounted knights of the Middle Ages rode war horses, which made them a potent combination of mass and acceleration and produced a fearsome visual impetus for shock. In the 15th century, the European *destrier*, or war horse, was a genetically refined and well trained complement to the mounted knight's basic style of fighting. Just as size and endurance might be bred into a mount, so might other psychological characteristics, such as aggression. Reinforced with training to accentuate its natural tendencies, the war horse of the Middle Ages was a fearsome beast in its own right. Trained from a colt to obey the subtle commands given by leg pressures from its rider, it was also trained in more violent actions. Biting opposing horses, kicking dismounted warriors in the melee, each of these 2,000 pounds of directed mass could impart a mighty impact by themselves.

When coupled with the knight and his intelligent mass, at a velocity of nine meters per second, which might be converted into a rapid deceleration upon impact, the mounted war horse was a weapon custom-made for producing shock. There was one major problem, however: mounted knights were not inclined by training or culture to act in a truly concerted manner. Each knight was an individual warrior, and for a long time this was enough. They stood dominant against all but similarly equipped foes throughout the Middle Ages until they ran into an even more efficient weapon, the Swiss phalanx of the 14th and 15th Centuries.

Success for the Swiss relied upon the phenomena of shock. At the time of the Swiss ascension, shock had been the sole purview of the mounted heavy cavalryman and his steed. The infantry had been relegated to a supporting, largely defensive role on the battlefield. The Swiss changed this equation with their attacks in massed columnar formation wielding 18 foot-long pikes. In their attacks upon their opponents, the Swiss were helped not only by the physical component of shock, but also by the psychological aspect, upon which they capitalized. By taking no prisoners and bowling over their opponents in near-fanatical attacks, the Swiss *Eidgenossen*[2] embodied the very essence of both components which create shock in an opponent.

Key battles fought by the Swiss demonstrate both elements of shock in operation. At the battle of Sempach in 1386 the Swiss attacked in a deep column formation, sometimes described as a "wedge" due to its unusual depth-to-frontage ratio.[3] This formation permitted the Eidgenossen to literally bowl their opponents over. Later, in what might be their ultimate example of the power of fear as a weapon, the Swiss attacked a numerically superior combined arms force at Grandson in 1476. Faced with the sudden onslaught of opponents that had never retreated, never accepted a surrender, and never lost while there was still a man among them alive, the Burgundians and their allies literally dissolved before the Swiss ever had the chance to make contact with the opposing infantry.

Moving forward into the age of gunpowder, Napoleon's attacks with *L'Ordre Mixte*[4] again demonstrated the power of shock when a mass of combatants attacked in a "columnar" formation. Even this far into the gunpowder era, the threat of "cold steel" could and did break many formations facing the charge of a French formation in column. The visible physical mass and combined will of the French formations were often enough to cause others to break, despite their inherent lack of firepower (due to a reduced frontage relative to a defender "in line"). Later, in the American Civil War, similar tactics were used. By then. the increasing range of artillery and rifled musketry created prohibitively high casualties before most bayonet charges could be run home. Recent studies involving the medical records of the Union Army reveal that even in those fights that did contain a successful bayonet charge, there were surprisingly few actual wounds inflicted by the bayonet. Units apparently broke before the attacking ranks collided with the defenders. A mass process appears to occur in which the defenders continually evaluate the chances for success of the attackers. If the attackers begin a final assault which the defenders did not feel they could stop with firepower, the defenders would often break. The level at which they broke would appear to be a function of the discipline and training of the unit. Similarly, in the attack, there could occur the "culminating moment" when the attackers individually and collectively conducted a similar analysis. If, in their minds they had passed the point where they believed they might succeed, attackers too might quickly dissolve. Classic examples of this are the "High Water Mark of the Confederacy" at Gettysburg[5] and the failed attack of Napoleon's *Grognards* (The Imperial Old Guard) at Waterloo. In the case of Waterloo, the cry of *Les Guard recule* set in motion the dissolution of the entire Grande Armee.[6]

The First Component: Force

Force equals Mass times Acceleration. It is a simple equation, one that is repeatedly demonstrated every fall weekend in stadiums across the United States. While the mechanical method that deliv-

ers the force may differ from the Eidgenossen, to the Big Ten linebacker, to a battalion task force at the National Training Center (NTC), the same formula applies. That force has a large role in warfare is obvious; what is not quite so evident is the role of force as a component of shock.

Shock, as we hope to inflict it, is not an individual phenomenon. This is where some of the confusion in definition appears. Shock, as defined here, affects the actions of large bodies of men, causing the retreat or surrender not of scattered individuals but of entire units. The shock we would like to inflict upon our opponents (and prevent from occurring to us) affects whole companies and battalions, perhaps even brigades at a time. The disintegration of Naploeon's Grand Armee is what we are aiming for as a goal. How then does force apply within this context?

First, force must be demonstrable. The cause of the effect (hopefully, friendly forces) must be present and visible for force to develop any psychological impetus, as we will see later. Further, the effects of force, whether from a single weapon or the massed effects of many weapons, must be visible to numerous members of the opposition. For shock to develop, both of these elements must be present when the physical process of force application occurs. This partially explains why so few units in the past century have ever surrendered due to the pummeling received from airpower alone.[7] Similarly artillery, while it may contribute to the effects upon morale, also remains (by itself) less than decisive. Attack aviation, while meeting the criteria of visibility and presence, also fails for the same reason as conventional fixed-wing aircraft. It may attack and infuse shock, but any opponent facing an attack helicopter knows that it cannot drive home its attack. It is also impractical to surrender to a helicopter, though the Iraqis set records in this department for trying.

To fully understand this we must turn again to the historical record. Military history is rife with examples; it remains only to choose one for an analysis to demonstrate the components. For example, how did physical force affect the recipient of the Eidgenossen attack? The Swiss pikemen with their long weapons faced armored knights fighting both on horseback and later on foot. How did they develop the force required to defeat the armor of the knights, and was this physical force sufficient to explain their long series of one-sided victories?

Simply stated, it is doubtful that most Eidgenossen pike tips actually penetrated the armor of a knight standing ready to accept the rushing charge of the Swiss phalanx.[8] The Swiss pike was not an Armor Piercing Fin Stabilized Discarding Sabot munition with sufficient kinetic energy to slice through plate mail. What they did do was bowl over their opponents, killing some in the initial rush, stabbing others as they lay on the ground as the Eidgenossen walked over them, continuing their attack. The result was literally a wake of dead bodies trailing in a path behind the Eidgenossen phalanx. Their deep formations permitted them to accumulate sufficient kinetic energy through additional mass to make up for what they lacked in acceleration, but this kinetic energy was used in maintaining the momentum, not acceleration. The results were visible, gruesome, and apparently (to their opponents) inevitable for any that stood up to the charge of the Swiss.

For a similar reason, some of the attacks of the British tanks at Amiens in 1917 met with unprecedented success for the time. The physical presence of an impenetrable object, rolling over German trenches and destroying those machine-gunners that did stay by their guns at ranges of as little as four to eight feet, combined with the visible presence of mass (represented by the tank itself) and with the undeniable power of its numerous machine guns or cannon[9] amply demonstrates the point. As examples of the power of force in ground combat, these stand alone. ***Force is the physical component; it may be relayed by manpower, or explosives, or projectiles or a combination of all three.*** Yet, as stated, shock has a second element, one which is prompted by Force.

Shock's Second Component: Fear

We need to dissect fear to understand how we might use it as a weapon. Fear is the basis of mass shock, yet it cannot be replicated in training and is one of the great imponderables of warfare. By what physical process may fear be conveyed, and how is fear transmitted after that?

Fear may be conveyed by a variety of methods. On a strictly physical level, the senses which transmit messages which might induce fear are obvious, primarily what the defender sees and hears. Fear is not directly transmitted, of course, but here we'll examine a series of sensory inputs which, when combined with knowledge inside a human animal, create the emotion of fear. It is that combination which the Eidgenossen and other

successful forces since their day capitalized on to great effect. Placing visual and audible sensory signals upon the battlefield, combined with their opponents' "knowledge" of their reputation, created fear. This is a worthy goal for our forces.

What are some examples of these "signals"? Audible inputs are easiest to demonstrate. The feeling of power conveyed by sound alone is obvious to anyone who has ever been near a large body of marching or jogging troops, let alone the roar of a large diesel engine or the reverberations of a tank main gun discharge. Massed rifle fire in volley is especially impressive, even if the smoothbore muskets that first used massed volley fire were not. The Swiss were known to use drums as their primary instrument. Today, it is not known if these drums were used to help the Eidgenossen stay in step, or merely to convey some rudimentary messages (such as "Speed up"), but their emotional effect was surely intentional. The drums helped hearten the Eidgenossen and helped strike fear into their opponents.

In our own century, we can see that mere sound still retains a place upon the battlefield. The physical force of the Luftwaffe's JU-87 Stuka dive bomber was not increased by the addition of the famous screaming dive sirens that were added to the aircraft. Yet many of the men that suffered through a Stuka attack would attest that the siren was a weapon, a psychological weapon designed to increase fear.

Fear is also generated through the sense of sight. The mass of the Swiss phalanx itself might be considered a weapon. Mass, organized personnel are considered dangerous, sometimes out of all proportion to their actual size. Consider recent examples, such as events which occurred during the U.S. involvement in Somalia in 1993. By experience, the soldiers and officers of the 1st and 2nd Battalions, 87th Infantry of the 10th Mountain Division (Light) learned similar lessons. Somalian rioters, when faced by small contingents of U.S. troops, barely paused in their activities. The U.S. troops acted in dispersed elements so as not to appear "confrontational" to the "peaceful" Somalians. When these U.S. troops were initially dispersed throughout a troublesome area in squad and fire-team sized groupings, their effect was negligible. However, when the same number of troops combined into a platoon or company-sized "riot" formation, their effect was sudden and visible upon the Somalians. On more than one

occasion, the simple act of "forming ranks" by the U.S. troops was enough to convince the rioters to cease their activities and cause some to disperse. (That is, until they learned that the U.S. forces would not resort to physical or deadly force unless attacked directly or fired upon. This discovery lessened the effectiveness of U.S. troops considerably.) From this we see that the visual stimulus of a compact, massed, and coherent force has more effect than the same number of troops in a loose or open formation. Sound and visual cues combined would be useless without some "knowledge" of what these stimuli might mean. It is the interpretation of the stimuli, and the human imagination acting upon that interpretation, which creates that thing we call fear.

One is not afraid until you have something to be afraid of, be it bogeymen or Eidgenossen. Further, even when given an object, one still needs an imagination. Fear appears to affect reality when input stimulus and mental object combine and the human mind imagines what the effect of the object of his fear might be upon him. From their very beginning as a unified and cohesive force at Morgarten in 1315, the Swiss created for themselves a reputation of invincibility and utter contempt for the human lives of those that opposed them. Later, they would add to this an apparent disregard for their own lives by their actions at St. Jacob-en-Birs, which further reinforced their reputation.[10]

From this we discern that fear requires a stimulus. This stimulus is most often visual or audible. The stimulus acts upon a preconceived notion regarding the force which the enemy will impart upon the subject. In other words, "What will happen to *me* when that tank that I hear/see decides to attack me?" If the threat is sufficient, and the message clear, then that *individual* will likely "break." He will become combat ineffective. However, that is but one individual. Shock, as we hope to see and understand it, refers to entire units. How does this occur? Surely different men have differing tolerances affecting their behavior. Societal norms, personal upbringing, and institutional forces combine within each man to create a unique point at which he will decide, "enough is enough" and try to escape the arena of combat as an individual. This is the essence of the military definition of "shock."

Fear and Dissolution

Simply put, the Swiss 18-foot pike was a fearsome individual weapon. In order

for the Swiss to experience the success which they enjoyed so often in the earlier years of their primacy (1338 to approximately 1450, for purposes of this discussion), they must have faced irresolute opponents. When stopped, the invariable Swiss response was to bring forward their true killing weapons, the halberd. But when an enemy was not so inflexible and gave way, the pike could be very effective. Its force would carry men off their feet, there to be trampled over by the onrushing impetus of the Swiss formation and likely crushed or stabbed to death while on the ground by the swords or halberds of those in the sixth, seventh or following ranks of the Eidgenossen formation. This is how their opponents died. The process could be accelerated by the presence of fear in the enemy ranks.

Facing the initial onrush of the Swiss attack, many men in the front ranks arrayed against the Swiss would pull back from the hedge of pikes. Some, of course, would die in the initial thrust, while others might be wounded and fall to the ground. Still more would trip as they backed away, and their falling could create a "shock-wave" of its own. Imagine a tightly packed crowd. Knock down a man in the leading edge of this crowd and literally dozens will be carried to the ground with him. None within the crowd have the room to catch their balance, which causes them to fall into others in the same predicament. Prone opponents are easier to kill than standing ones, if you are Eidgenossen and have no qualms about this minor breach of protocol, then you can take advantage of this event. But this scenario is not complete. Even given the self-perpetuating nature of what is described above, and adding in the continuing impetus of the Eidgenossen themselves, there is just not enough damage inflicted to explain the crushing defeats handed out by the Eidgenossen in their early years of dominance.

It is a military truism, first advanced in its present form by Ardent DuPicq, that more men are killed in the retreat than are killed while facing the enemy.[11] It is also an observed fact from the period under discussion, and later battles through the 19th century, that when a unit broke, the break started from the rear of the formation.[12] This would appear to be counter-intuitive, but the observations recorded by contemporaries are clear. This led to the "File Closer" role of the early noncommissioned officer. Stationed at the rear of the formation, with his sword (or pike) extended

lengthwise, he "closed the files" and added strength to the most vulnerable location in the formation. Breaks in the rear of the formation were most likely due to the aforementioned "pyramid" effect which densely packed formations have upon the men within these formations, but with a message-bearing psychological force being the impetus, instead of a physical force. A message of impending assault passed from the front ranks (that can see the reality) to the rear ranks. The message may move like a sentence in a game of "I've Got a Secret," becoming amplified at each successive rank until the rear ranks receive a message of doom. If fear is the current, then massed formations served as excellent conduits. Which brings us forward in time to the twentieth century.

The Fading of Shock

If there has been one constant on the twentieth century battlefield since the First World War it has been the phenomena of the "empty battlefield." Today, we rarely consider during our tactical decision-making process that there might have been another way; every soldier and leader currently in service has served with this as a given. Yet the shock described up to this point relies upon a massed formation to efficiently and quickly transmit its message of terror. The implications of the modern characteristics of battle are similarly evident in the historical record. Shock faded.

Without a large body of men rapidly passing a defeatist message to each other, the classic effects of shock, though pursued, were seldom attained. Rarely in the twentieth century have entire battalions, divisions, or corps literally quit the battlefield when their reserves of courage had been expended. This is obviously not due to a lack of applied violence (force) or a greater level of courage possessed by the soldiers of this era compared to all human history. What has been missing is the ability for one soldier suffering from individual shock to pass his message of despair to a large number of other soldiers simultaneously. Dispersed, and fighting in increasingly smaller and more autonomous elements, the modern soldier's actions did not have relevance to the same number of personnel as they had previously. In those cases where troops were "shocked" and broken by the event, the troops in question were more often rear-echelon units attacked and surprised by an enemy conducting a breakthrough or deep penetration. They were not, as had been the

case earlier, front-line combat elements. This partially explains the greater significance of the "breakthrough" or "penetration" in modern tactical and operational thought. Rather, the common denominator for most apocryphal stories in this century refer to combat units that held out against improbable odds in separated pockets of resistance. The attack of the German Wehrmacht in the Ardennes in the winter of 1944 is rife with such accounts.

Anomalies occur, however, when the weapon itself is sufficient to convey the message to all that see the weapon, let alone encounter its effects. During the twentieth century, this has been the almost exclusive purview of the heavy tank in an offensive role. A single tank, unlike an entire company of infantry, is by comparison extremely visible. While the infantry relies upon the earth to serve as both protection and concealment, the tank with its massive bulk finds this much more difficult in the offense. As a result, the tank has had the potential to convey shock to ground units as has no other force. Its visible presence replicates the effects which an implacable formation of Eidgenossen might have had upon a defender. From this effect, no less than its actual ability to impart force upon the enemy, has Armor earned the sobriquet of the "Combat Arm of Decision." Fully understanding how armor affects an enemy, both physically and psychologically, what can we say about the future?

The Future of Shock

Does shock have a role to play upon the battlefield of the present and the future? For the present I would suggest that the Iraqi Army provided us a definitive answer. However, as most professionals will readily concede, the Gulf War was custom-made for the employment of United States heavy weapons and doctrine. What of those future "less than perfect" wars? How might we convey shock there? Shock will play a role in war so long as human animals continue to feel fear. Perhaps more importantly, and up until now unconsidered, how might we prevent our forces from being shocked? This last leads to one critical question to which the United States Army should devote more attention. Are we, with our new reliance and emphasis upon the "digital warrior" and

total information dominance, opening ourselves to a new era of shock?

Let us review what it takes to be affected adversely by shock. First and foremost, there must be a threat. Some physical entity must be able to convey real force. This is firepower. Artillery, CAS (close air support), attack helicopters, the main gun of an M1A2, or the fires from an M60 machine gun all meet the requirements. Choosing the appropriate weapon and placing that weapon in a position where it may inflict real damage is the traditional definition of the art of war at the tactical level. These weapons are often most effective when used in combination, hence "combined arms" has been the byword of professional organizers of mass violence for several centuries. Following the impact of physical force, there must be a mental image of the attacker, some reputation which the force of the weapons being employed serves to reinforce in the mind's eye of those being attacked. This aspect has an obvious counter-force acting upon the subject, the counter being the combined elements of discipline and morale. Simply stated, there is an inverse relationship between the effectiveness of a threat upon a subject and that subject's morale/discipline*. The higher the morale/discipline, the more firepower may be required to impart sufficient mental violence upon the subject to cause him to "break."* Conversely, a defender with a low morale/discipline may require less firepower applied before he decides to quit the field of battle.

This is all very well and good, but what have these obvious statements about warfare have to do with our future?

Here, the third factor applies. In the above paragraphs, the actions and forces acting upon a single individual were considered. On the "empty battlefield" of the twentieth century, especially after the First World War, it was primarily only a single element which might be affected. Thus, more and more firepower was required to affect enough individuals in a single area so that a breakthrough might occur. The cumulative effect disappeared with the massed formations of the nineteenth century. Now, however, we are planning to place the ability to "see" the whole battlefield into the hands of every soldier in a way that

they have not been able to since the nineteenth century!

Consider, in even the least visionary of these proposed technological schemes, that every soldier has at least a limited ability to "see" most of the battlefield over which his unit is operating. Graphical map displays embedded within a clear visor worn by the infantry private of the future will show the location and relative position of all of his fellow soldiers. The IVIS display which a sergeant may call upon within his M1A2 today will show to him how many friendly units remain...and how many have died. A lieutenant may examine the positions and strengths of the entire battalion task force. The Signal Corps is understandably concerned with protecting the integrity of our signal transmissions. This may become doubly important as the information conveyed by these transmissions may soon show our soldiers that they are under attack by a force ten times the reality of what faces them.

What do you suppose the young men raised on Nintendo 64 will believe? The message conveyed by their eyes ("no enemy in sight yet" or "there is only one company attacking this platoon") or that of their "information warfare" machines ("there is an entire REGIMENT headed towards this exact location!!!") These men of the future, many of them in diapers today, are growing up believing in the reality which might be displayed upon a screen by pixels of varied color. The reality of the information conveyed by icons has already been noted as a stumbling block for senior Army leaders. They were not raised on computer games, and apparently have difficulty placing their full trust in what they see on a screen. Younger leaders, raised with computers from grade-school, tend to accept the information in our new "Windows for War" digital displays more readily. In the future, computer-generated screen icons may very well define reality to these soldiers and leaders that will man the equipment we field this decade. What if those icons lie? What happens when enough icons "go dim"? Have we opened ourselves to a new era where true and massive shock might again become a tactical reality?

There is a lesson and a warning within this article which is beyond my simple ability to fathom. It may be that we have

inadvertently reopened a door once closed that will allow the most technologically gifted army in the world to react as though they were nineteenth century troops of the line. Shock is imparted by physical force, which acts upon not only the flesh but the minds of those on the receiving end. When other armies of the world follow our lead, as they inevitably will, perhaps the field might again level out. But until that day, some thought should be devoted towards blunting the effects which our own weapons of information might have upon our soldiers, leaders, and units. So far, we have identified one single factor which might counter shock; that factor is discipline. While we all admire discipline, would any that read this suggest that our current average level of discipline is equal to that of, say, the British 45th Regiment of the Line at Waterloo? More to the point, is our peacetime conception of discipline up to the wartime standards that appear when danger looms? This is one aspect of the digitization movement which we need to address. Discipline is often seen as the antithesis of individuality. What we are hoping to create with digitization is a synthetic environment which will allow all elements to act independently, yet in a coherent fashion, to create synergy of effects. Independent actions frequently require independently-minded leaders, ones that rarely fit the traditional mode of "disciplined." (Note that this does not mean that independence equals effective, merely that it is another route to effectiveness.) But with these competing forces at work in our military culture, we should be wary about the long-term effects that we might create. We do not want to find ourselves "shocked" in the future because someone has placed a bug in our computers, and we believe the icons before we believe our own eyes.

Notes

[1]*The American Heritage Dictionary*, Ed. William Morris (Boston: Houghton Mifflin Company, 1982) s.v. "Shock."

[2]C.W.C. Oman, *The Art of War in the Middle Ages,* (Oxford, U.K.: Oxford, 1885; Ithaca: Cornell University Press, 1993), 79 ; "Oath Brothers" This title for the Swiss derives from the fact that they did not swear fealty to any feudal rulers but rather to each other. Some see this as a primary motivational source for their high level of cohesion in combat.

[3]J.F. Verbruggen, *Art of Warfare in Western Europe in the Middle Ages,* Europe in the Middle Ages Selected Studies, vol.1, ed. Richard Vaughn, trans. Sumner Willard, S.C.M. Southern (Amsterdam: North-Holland Publishing Company, 1977), 60.

[4]Gunther Rothenburg, *The Art of Warfare in the Age of Napoleon,* (Bloomington: Indiana University Press, 1978) 117. It should be noted that though these formations might be described as "columns," they do not meet the modern description. They were still wider than deep, massing men across a front of up to 40 while only maintaining a depth of 12 ranks. However, 12 deep was still 4 times the norm of 3 deep in "line" formation. Also, "The Mixed Order" was a temporary solution to a specific problem of the early Napoleonic armies. There is a shortage of well trained and disciplined soldiers among the large conscript armies raised to defend early revolutionary France. To counter this shortage, the "Mixed Order" placed one regiment of trained professionals in linear formation in the center, flanked and trailed by two regiments of less well trained conscripts. The role of the "regulars" was important, as their discipline and position allowed the enemy to be "pinned." The flanking columns would then march around their base of regulars and attack in column. As Napoleon's forces became more experienced, this demi-brigade structure was abandoned.

[5]George R. Stewart, *Pickett's Charge,* (Boston: Houghton-Mifflin Company, 1959), 245-246. The "High Water Mark" was a closer thing than many realize. Opposing the charge of the Confederates at the "clump of trees" was but a single line of infantry. These Union regiments, though undamaged by the preceding cannonade, were nonetheless severely understrength. The Confederates actually for a brief period attained their objective as fierce fighting occurred at "The Angle," then something, nobody can say for sure what, motivated the 72nd Pennsylvania to countercharge. This desperate rush broke the will of the Confederates. Brutal hand-to-hand fighting occurred, men literally attempted to choke each other to death, but it lasted only seconds. Then the Confederates broke. One Sergeant Kimble stated, "For about a hundred yards I broke the land speed record." If a sergeant freely admitted this, one can guess how the lower enlisted had moved.

[6]John Keegan, *The Face of Battle,* (New York: Penguin Books, 1978), 178.

[7]*The Italian Campaign,* Ed. Robert Wallace (Alexandria, Va.: Time-Life Books, 1978), 23. In May 1943, the Italian garrison of the island fortress on Pantelleria surrendered after five weeks of continuous bombardment. This island stands between Northern Africa and Sicily; its capture was critical for the following invasion of Sicily. On 10 May 1943, British forces landed, the sole casualty was a Tommy bitten by an ass. The ass's name, rank, and unit were not recorded.

[8]The force of pike on armor = force of armor on pike. Therefore, the force applied by tip of pike = force to bring pike-bearing Eidgenossen to a stop. But over what distance (i.e.- recoil distance of armor wearing knight) or in what time? If armor cannot recoil, then let's assume pike bearing soldier must be stopped in 1 millisecond. Then acceleration (deceleration) from velocity of 3 m/sec (~9 ft/sec) to 0 m/sec in 0.001 sec = 3000 m/sec/sec and the force to stop an 80 kg Eidgenossen would be 240,000 Newtons. This is a significant force, sufficient to penetrate feudal armor. To reach that sort of deceleration, the armored knight must either be braced in place (by the mass of troops behind him most likely) or be moving forward himself. He need not move at near the same speed as the attacking Eidgenossen to develop the same kinetic energy because his increased mass (due to the armor) will compensate for his reduced speed. This is how an Eidgenossen pike point might penetrate armor. However, given the chance (or skill) to recoil with the tip of the pike over a distance of as little as 1.5 meters (approximately 1 sec required) the force is reduced at any one moment to 240 Newtons. Think of catching a football with "soft hands" versus "hard hands." These distances are easily calculated with the following formulas: $F = m*a$ and $d = 1/2*a*t*t$.

[9]S.D. Rockenbach, Colonel, "Tanks in Battle of Amiens," *Infantry Journal*, Vol. XXI, No. 2: August 1922.

[10]Oman, *The Art of War in the Middle Ages*, 96. At St.-Jacob-En-Birs, a Swiss force between 1,000 and 1,500 men deliberately crossed the Birs river and assaulted a force of French troops numbering roughly 40,000! All the Swiss were killed, but not before the French lost over 2,000 of their own. This deliberate disregard for their own lives, coupled with the ferocity of their attack, convinced the French commander that further progress in his planned invasion would be suicidal. The Swiss attacking him had been merely the ADVANCE GUARD, not the main body he could later expect. The French returned to Alsace following this engagement and the Swiss reputation was sealed.

[11]Du Picq, Ardant, *Battle Studies: Ancient and Modern Battle,* trans. from French.

[12]Keegan, John, *The Face of Battle,* 174-175. Keegan provides a very short analysis of the effects of mental shock upon those soldiers in following ranks while describing the action between infantry units of the British and French at Waterloo in 1815. This two-page passage is the specific impetus which led to this article.

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